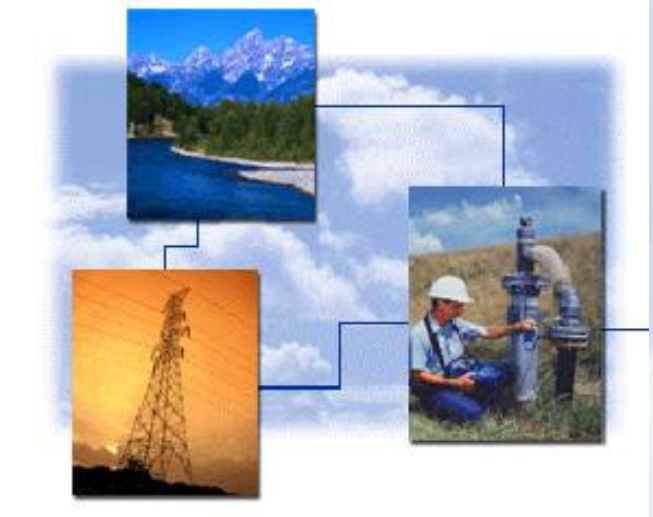
An Overview of Landfill Gas Energy in South Carolina and the U.S.



Sonny DuBose, SC Energy Office
LMOP State Partner

U.S. Environmental Protection Agency
Landfill Methane Outreach Program (LMOP)

LANDFILL METHANE OUTREACH PROGRAM

Why Does EPA Care About LFG?

- Methane is a potent heat-trapping gas
  - Landfills are largest human-made source in U.S.
- Many cost-effective options for reducing methane emissions while generating energy
  - Distributed generation
  - Direct use at local industrial facilities
- Use an otherwise wasted resource
- Promote jobs, economic development, and cost savings
- Projects reduce local air pollution

EPA's Landfill Methane Outreach Program

- Established in 1994
- Voluntary program that creates alliances among states, energy users/providers, the landfill gas industry, and communities

Mission: To reduce methane emissions by lowering barriers and promoting the development of cost-effective and environmentally beneficial landfill gas energy (LFGE) projects.

Landfill Gas 101

- Landfill gas (LFG) is a by-product of the decomposition of municipal solid waste (MSW):
  - ~ 50% methane (CH_4)
  - ~ 50% carbon dioxide (CO_2)
  - <1% non-methane organic compounds (NMOCs)
- For every 1 million tons of MSW:
  - ~ 0.8 MW of electricity
  - ~ 432,000 cubic feet per day of LFG
- If uncontrolled, LFG contributes to smog and global warming, and may cause health and safety concerns

LFGE Projects Provide Dual Benefits

- Destroys methane and other organic compounds in LFG
- Offsets use of nonrenewable resources (coal, oil, gas) reducing emissions of:
  - SO_2 contributes to acid rain
  - NO_x contributes to ozone formation and smog
  - CO_2 is a global warming gas
- Each 1 megawatt (MW) of generation capacity:
  - Annual environmental equivalent to planting 12,000 acres of trees or removing the CO_2 emissions of 9,000 cars
  - Annual energy equivalent to preventing the use of 99,000 barrels of oil, offsetting the use of 200 railcars of coal, or powering more than 650 homes

Currently Operational LFGE Projects in South Carolina

- Horry County LF, Conway – 3 MW of electricity generation for Santee Cooper
- Palmetto LF, Wellford – 9.5-mile pipeline to BMW to produce 4.4 MW and hot water, and fuel paint shop (counts as 2 projects)
- Lee County LF, Bishopville – 5.4 MW of electricity generation for Santee Cooper
- Screaming Eagle LF, Elgin – 5.5 MW of electricity generation for Santee Cooper

South Carolina Estimated Annual Environmental Benefits

- **Currently Operational** – 5 projects (18 MW and 800 scfm)
  - Planting **57,000 acres of forest**, or
  - Removing emissions equivalent to **40,000 vehicles**, or
  - Preventing the use of **488,000 barrels of oil**.
  - Annual energy savings equate to **powering 11,400 homes** and **heating 2,600 homes**.
- **Potential** – 20 MW from 15 candidate landfills
  - Planting **142,000 acres of forest**, or
  - Removing emissions equivalent to **100,000 vehicles**, or
  - Preventing the use of **1.2 millon barrels of oil**.
  - Annual energy savings equate to **powering 12,000 homes**.

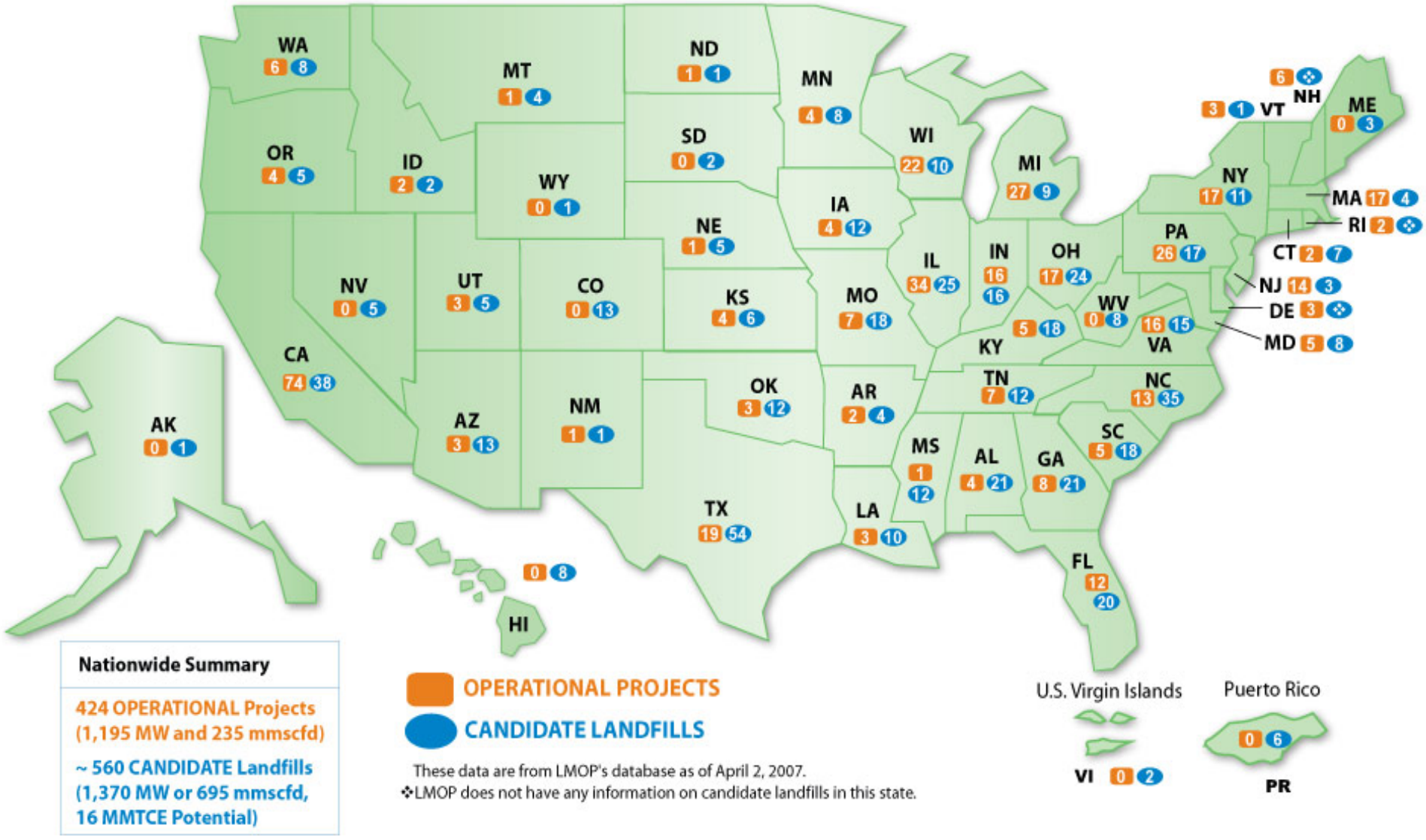
South Carolina Candidate Landfills in LMOP Database

- Bees Ferry Road, Johns Island
- Berkeley County
- Camp Croft, Spartanburg
- Enoree, Greer
- Georgetown County
- Greenwood County
- Hickory Hill, Ridgeland
- Northeast, Columbia
- Northeast Sanitary, Eastover
- Oakridge, Dorchester
- Pendleton
- Seneca
- Starr
- Three Rivers Regional, Jackson
- Wellford

LMOP Partners Located or Involved with Projects in SC

- **Community Partners**
  - Anderson County Environmental Services Division
  - Berkeley County Water and Sanitation Authority
  - Georgetown County Environmental Services Division
  - Greenville County
  - Greenwood County Public Works
  - Horry County Solid Waste Authority
  - Lexington County
  - Spartanburg County Public Works
  - Sumter County
  - Three Rivers Solid Waste Authority
- **State Partners**
  - SC Energy Office
- **Industry Partners**
  - Duke Solutions
  - Environmental Control Systems, Inc.
  - GE Jenbacher
  - Jaderloon Company, Inc.
  - SCS Engineers and SCS Field Services
  - Synfratech
- **Project Developer Partners**
  - Ameresco, Inc.
  - Durr Systems Inc.
  - Enerdyne Power Systems, Inc.
  - Republic Services, Inc.
  - Waste Management, Inc.
- **Energy Partners**
  - BMW Manufacturing Corporation
  - JW Aluminum
  - Milliken & Company
  - Santee Cooper
- **Endorsers**
  - Home Builders Association of SC
  - Municipal Association of SC
  - SC Association of Counties
  - SC Association of Realtors
  - SC Chamber of Commerce
  - SC Palmetto Chapter of SWANA

Landfill Gas Energy Projects and Candidate Landfills



State of the National LFGE Industry (Apr 07)

- At least 424 operational projects in 40 states supplying:
  - 10 billion kilowatt hours of electricity and 75 billion cubic feet of LFG to direct-use applications in 2006
- Estimated **Annual** Environmental Benefits:
  - Planting **~20,000,000 acres of forest**, or
  - Preventing the use of **~170,000,000 barrels of oil**, or
  - Removing emissions equivalent to **~14,000,000 vehicles**, and
  - Powering over **780,000 homes** and heating nearly **518,000 homes**.

There Are Still Many Untapped LFG Resources

- Currently ~560 candidate landfills with a total gas generation potential of 700 million cubic feet per day or ~14,800 MMBtu/hr
- Total expected annual environmental benefits if all projects were developed/ producing energy:
  - Planting 15.5 million acres of forest, or
  - Removing the emissions from 11 million vehicles on the road, or
  - Powering 870,000 homes per year

Diversity of Project Types
Electricity Generation

LANDFILL METHANE OUTREACH PROGRAM

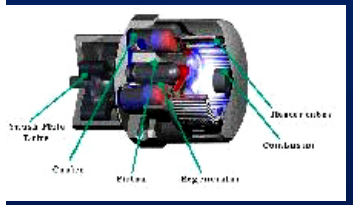
Internal Combustion Engine

Gas Turbine

Emerging Technologies

Microturbine

Organic Rankine Cycle Engine



Stirling "External Combustion" Engine

Landfill Gas and Green Power
A Winning Combination

- Dual benefit ➡ destroys methane and other organic compounds in LFG
- Offsets use of nonrenewable resources (coal, oil, gas) reducing emissions of
  - SO_2 , NO_X , PM, and CO_2
- LFGE is a recognized renewable energy resource
  - *Green-e*, EPA Green Power Partnership, Sierra Club, NRDC
- LFG is generated 24/7 and projects have online reliability over 90%
- LFG can act as a long-term price and volatility hedge against fossil fuels

Diversity of Project Types
Direct-Use of LFG

- Direct-use projects are growing!
  - Boiler applications - replace natural gas, coal, fuel oil
  - Combined heat & power (CHP)
  - Direct thermal (dryers, kilns)
  - Natural gas pipeline injection
    - Medium and high Btu
  - Greenhouse
  - Leachate evaporation
  - Vehicle fuel (LNG)
  - Artist studios
  - Hydroponics
  - Aquaculture (fish farming)

Greenhouse Burlington, NJ

Pottery Studio Sugar Grove, NC

LFG-fired Boiler Ft. Wayne, IN

LFG Has Been Used to Help Produce…

LANDFILL METHANE OUTREACH PROGRAM

- Aluminum
- Aquaculture (e.g., Tilapia)
- Biodiesel
- Biosolids (drying)
- Blacksmithed products
- Bricks and concrete
- Carpet
- Cars and trucks
- Chemicals
- Chocolate
- Consumer goods and containers
- Denim
- Electronics
- Fiberglass, nylon, and paper
- Furthering space exploration
- Garden plants
- Green power
- Ice cream, milk, and tea
- Infrared heat
- LNG/CNG vehicle fuel
- Orange, apple, and cranberry juice
- Pharmaceuticals
- Pierogies and snack food
- Pottery and glass
- Soy-based products
- Steel
- Tomatoes (hydroponic)
- Taxpayer savings and increased sustainability!

Jobs and Revenue Creation - National

- A typical 3 MW LFG electricity project is estimated to have the following national benefits (direct, indirect, and induced) during the construction year:
  - Increase the output of the U.S. economy by more than $10 million
  - Increase U.S. employee earnings by more than $3.0 million (wages, salaries, etc.)
  - Employ more than 70 people (expressed in full-time equivalents per year)

Air Quality Regulations Affecting LFGE

- LMOP introduced State Partners to help with permitting concerns (25 states have a State Partner)
- LFGE projects are affected by a variety of federal, state, and local air quality regulations:
  - NSPS;
  - Title V;
  - Maximum Achievable Control Technology (MACT);
  - New Source Review (NSR); and
  - Prevention of Significant Deterioration (PSD)

Pipeline Regulations and Permitting

- Is the pipeline going to cross or impede public property?
  - 49 CFR 192 - TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE: MIN. FEDERAL SAFETY STANDARDS ESTABLISHED BY DOT OPS
- Is the pipeline a distribution line or transmission line?
  - This will be determined by the local, state and federal requirements depending on the pipeline location and classification.

Federal Financial Incentives

- Section 45 Tax Credit
  - Electricity generation – 0.9 cents/kWh
  - Placed in service by 12/31/08
  - 5- or 10-year window for credits depending on placed-in-service date
- Clean Renewable Energy Bonds (CREBs)
  - National allocation of $1.2 billion
  - Current issuance period of 1/1/07 to 12/31/08
  - In 2006, IRS granted issuance of 36 bonds for LFG projects
- Renewable Energy Production Incentive (REPI)
  - Local/state government or non-profit electric co-op facilities
  - Online by 10/1/16
  - Payment for first 10 years of operation

State Financial Incentives

- SC Energy Office
- Economic development offices
- Database of State Incentives for Renewable Energy
  www.dsireusa.org
- LMOP Online Funding Guide
  www.epa.gov/lmop/res/guide/index.htm
- SC Landfill Methane Tax Credit
  www.sctax.org
  - Allows manufacturing facilities to claim up to 25% of their LFGE costs

Landfill Gas Energy: Negative Perceptions

- 'Zero Waste' concerns
  - "Environmental groups have been wary of using landfill gas to generate electricity, because they want to encourage recycling, not trash disposal."
  - *"But it is better to use landfill methane than to waste it…It's got a nice je ne sais quoi to it."*

    -- Nathanael Greene, NRDC


Honeywell
NUCOR
HILL AIR FORCE BASE, Utah
OGDEN AIR LOGISTICS CENTER
DART
CYTEC
Rolls-Royce
SENECA Foods.com
"A World Leader In Agribusiness"
Owens Corning
Cargill
Ford
The Ultimate Driving Machine
The Solae Company
Frito Lay
GM
LAFARGE
Look Who's Using Landfill Gas!
Jenkins Brick Company
AJINOMOTO
CONE
corporatedenimfinishingjacquards
Nestlé
Makes the Very Best
INTERNATIONAL PAPER
From innovation to results.
NASA
INTERFACE
MALLINCKRODT
DUPONT
The miracles of science
Lucent Technologies
Bell Labs Innovations
SC Johnson
DAIMLERCHRYSLER
TURKEY HILL
SUNOCO

LMOP 2003
Project of the Year

BMW Project Greer, SC

LMOP 2006
Energy End User Partner of the Year

LANDFILL METHANE OUTREACH PROGRAM

- 9.5-mile pipeline from Palmetto Landfill to BMW
- 2003 – 4 KG2 gas turbines retrofitted to burn LFG
  - 4.8 MW of electricity generated and 72 million Btu/hr of heat recovered
- 2006 – Converted paint shop to utilize LFG in oven burners and for indirect heating
- LFG accounts for nearly 70% of BMW's energy needs
- BMW saves at least $1 million/yr

"This LFG energy project allows BMW to take a wasted source of energy and use it to generate electricity, which benefits the environment and area residents through lower emissions."

Dr. Helmut Leube, President, BMW Manufacturing Corp.

Direct Use Case Study

SC Johnson & Son, Inc. Waxdale Plant Racine, Wisconsin

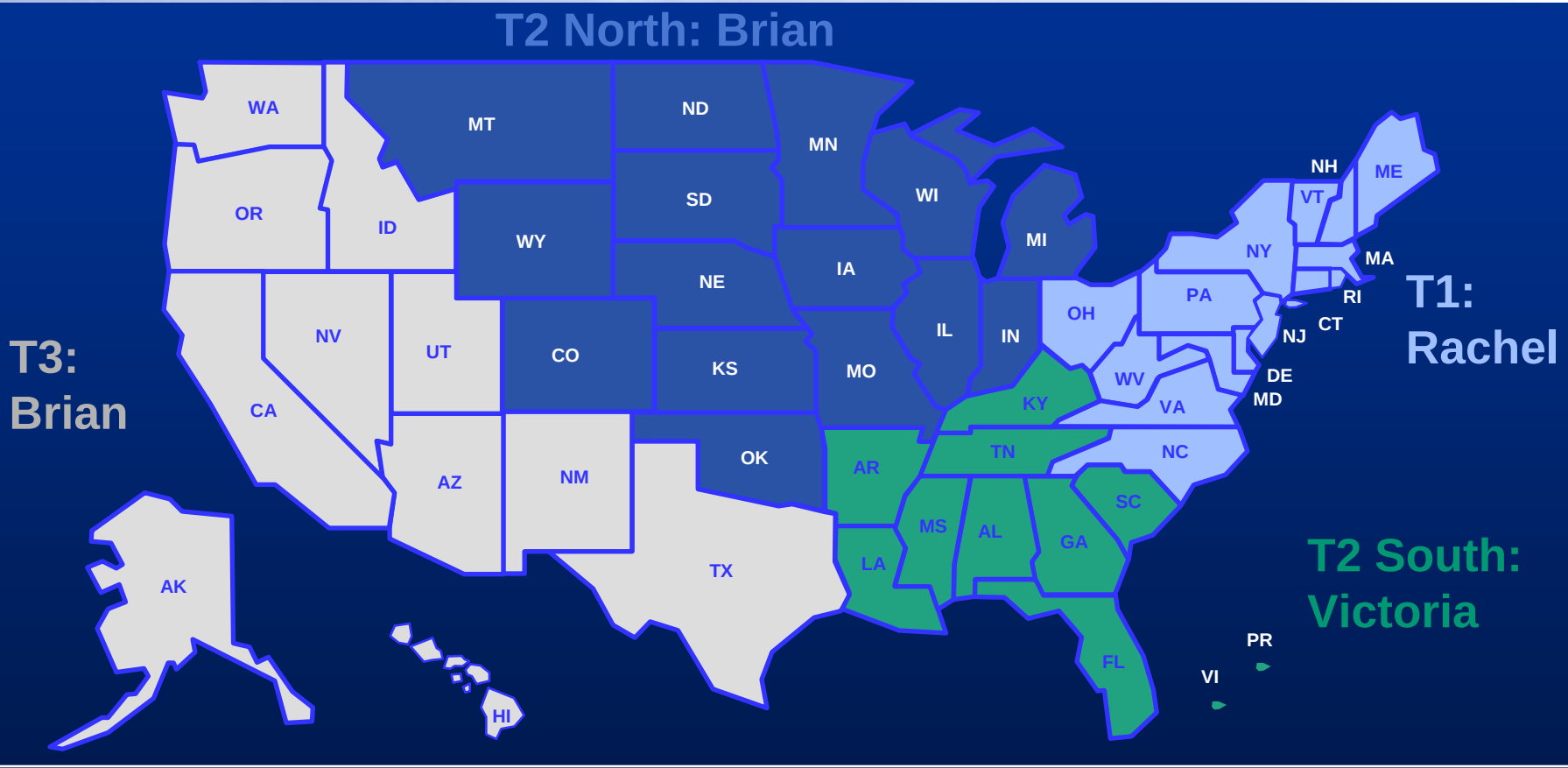
- Have used LFG in boilers for 14 years.
- Changed to a combined heat and power (CHP) LFG turbine project.
- Will produce 3.2 MW of electricity. Recover waste heat to produce 17,000 lb/hr steam.
- Reduce plant fossil fuel use by 50%. Reduce plant GHG emissions by 47%.
- Projected gross energy savings $2.4 million/yr (net - $1 million/yr).

LMOP Partner Recruitment Tools and Services

- Project and Candidate Database
- Green Pricing Accreditation Involvement
- State Workshops/Conferences
  - Working with State Partners and SWANA
- Peer Matching
- Web Site (e.g., publications, database)
- *Annual LMOP Conference, Project Expo, and Partner Awards* – Baltimore, MD January 2008

For More Information

www.epa.gov/lmop



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